FIG. 1

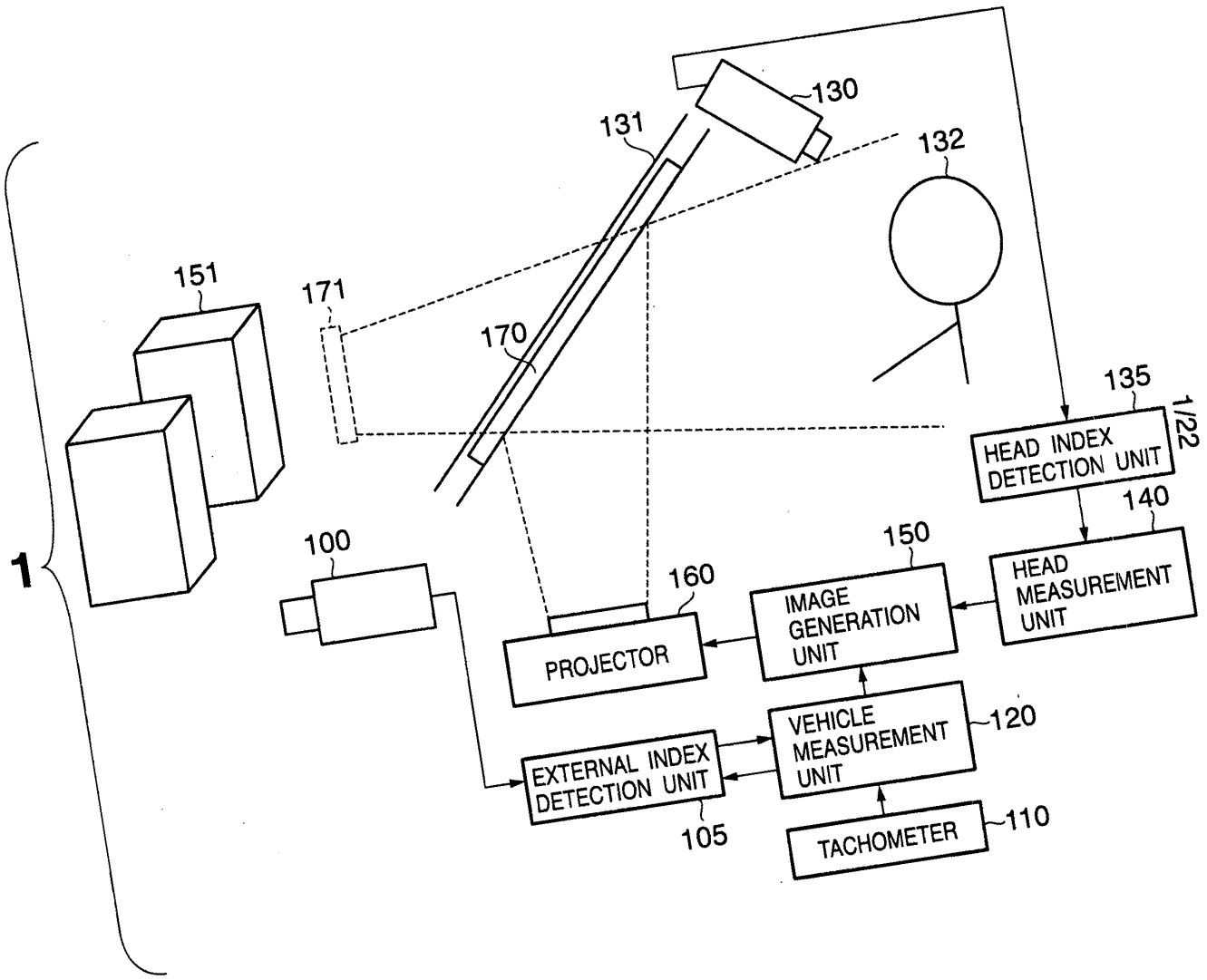

130
131
132
151
171
170
135
HEAD INDEX DETECTION UNIT
1/22
140
HEAD MEASUREMENT UNIT
150
IMAGE GENERATION UNIT
100
160
PROJECTOR
VEHICLE MEASUREMENT UNIT
120
EXTERNAL INDEX DETECTION UNIT
105
TACHOMETER
110

FIG. 2

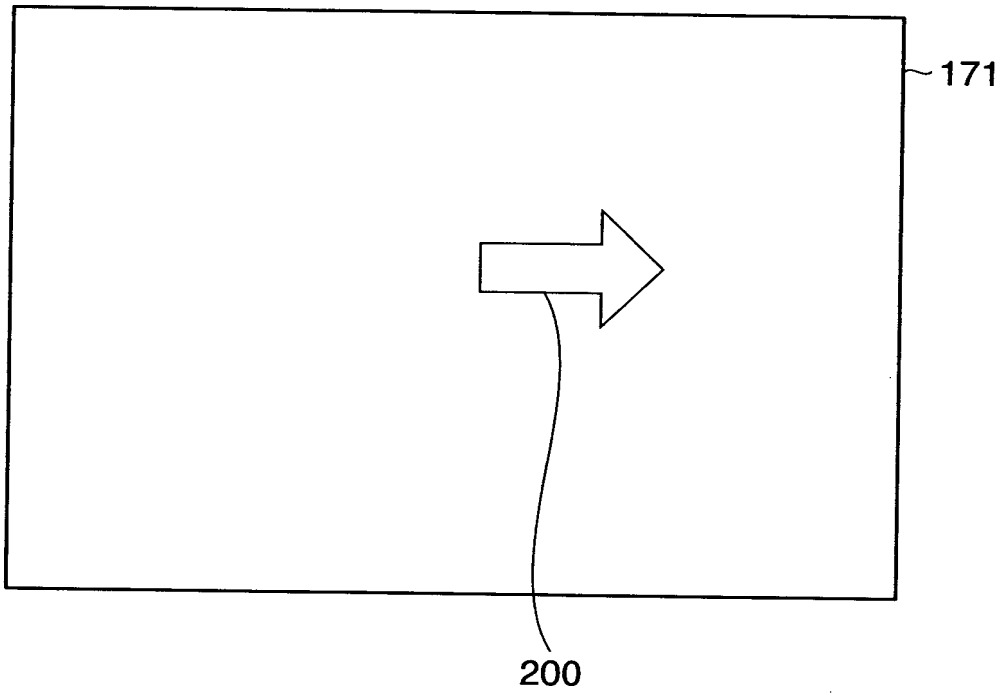


FIG. 3

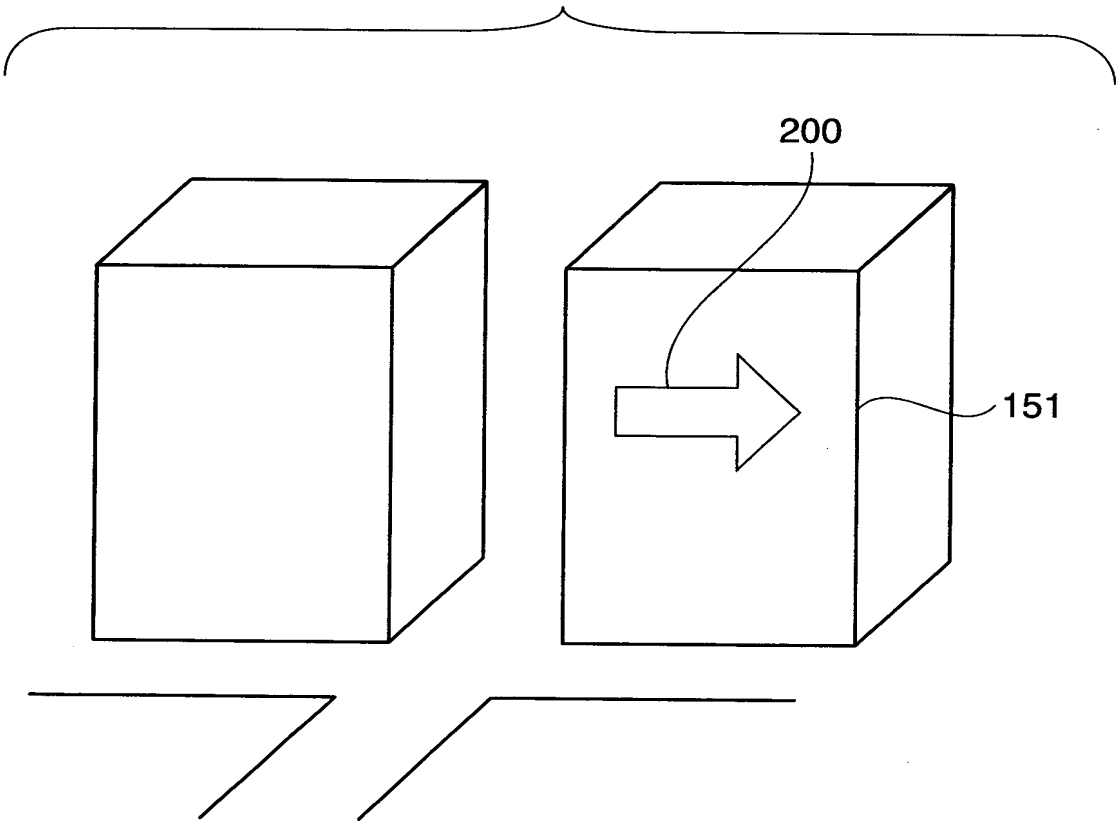


FIG. 4

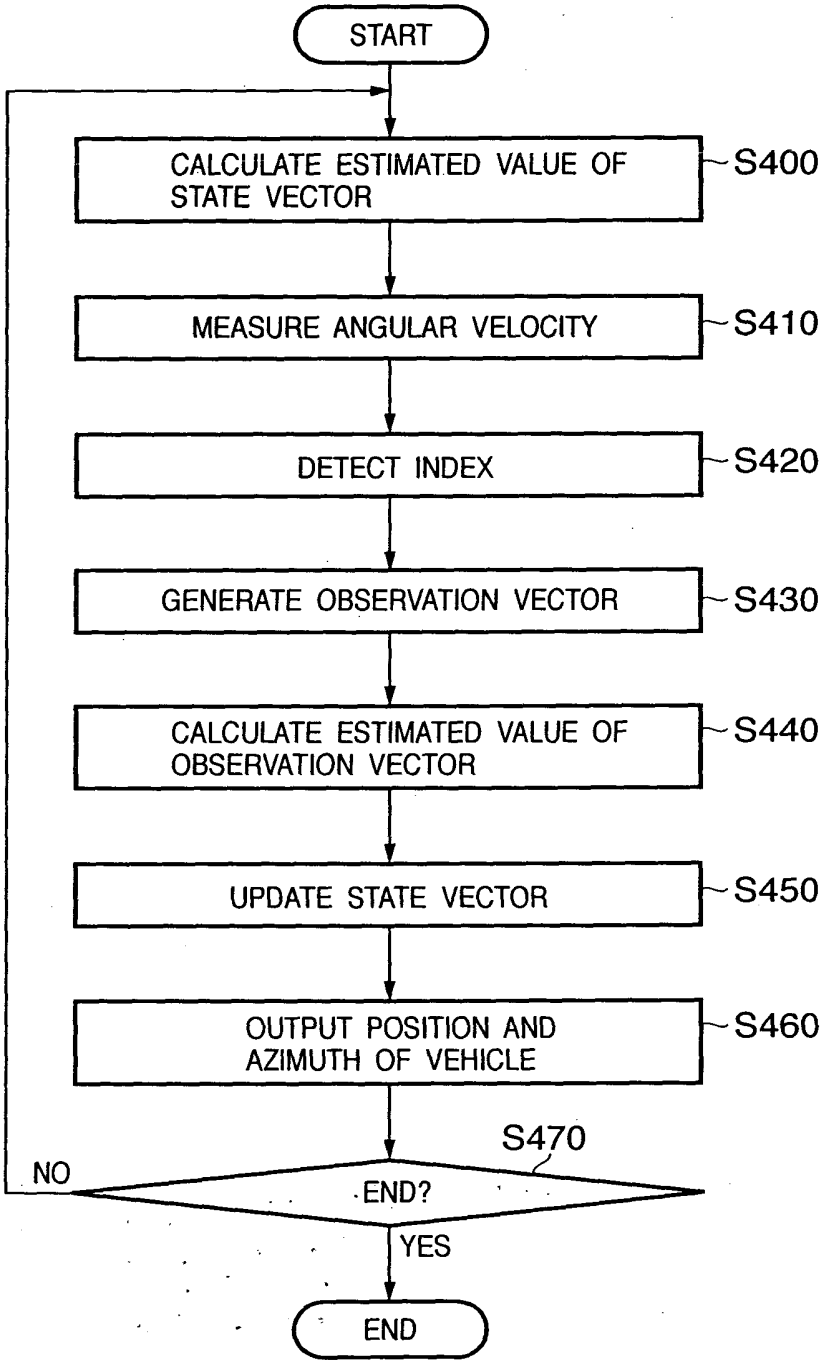

START
CALCULATE ESTIMATED VALUE OF STATE VECTOR
S400
MEASURE ANGULAR VELOCITY
S410
DETECT INDEX
S420
GENERATE OBSERVATION VECTOR
S430
CALCULATE ESTIMATED VALUE OF OBSERVATION VECTOR
S440
UPDATE STATE VECTOR
S450
OUTPUT POSITION AND AZIMUTH OF VEHICLE
S460
S470
END?
NO
YES
END

FIG. 5

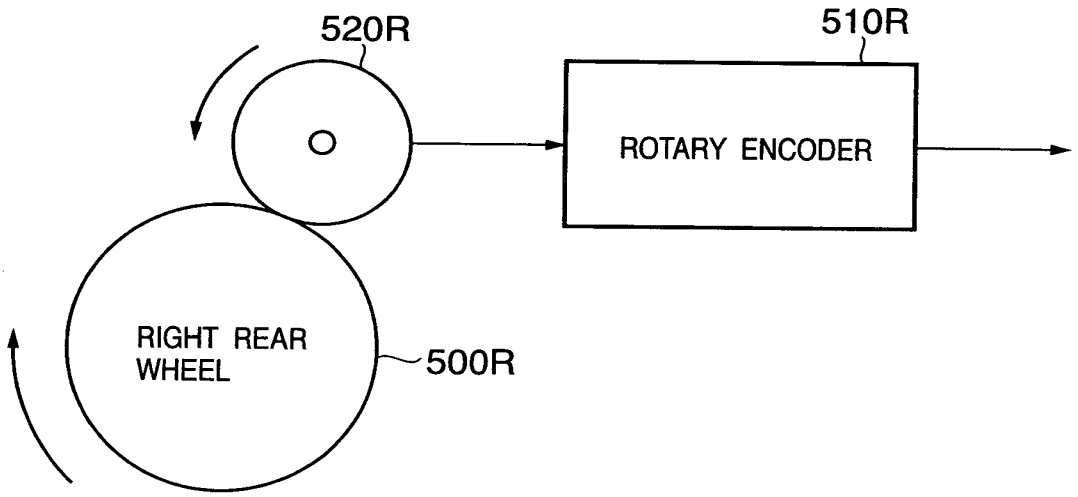


FIG. 6

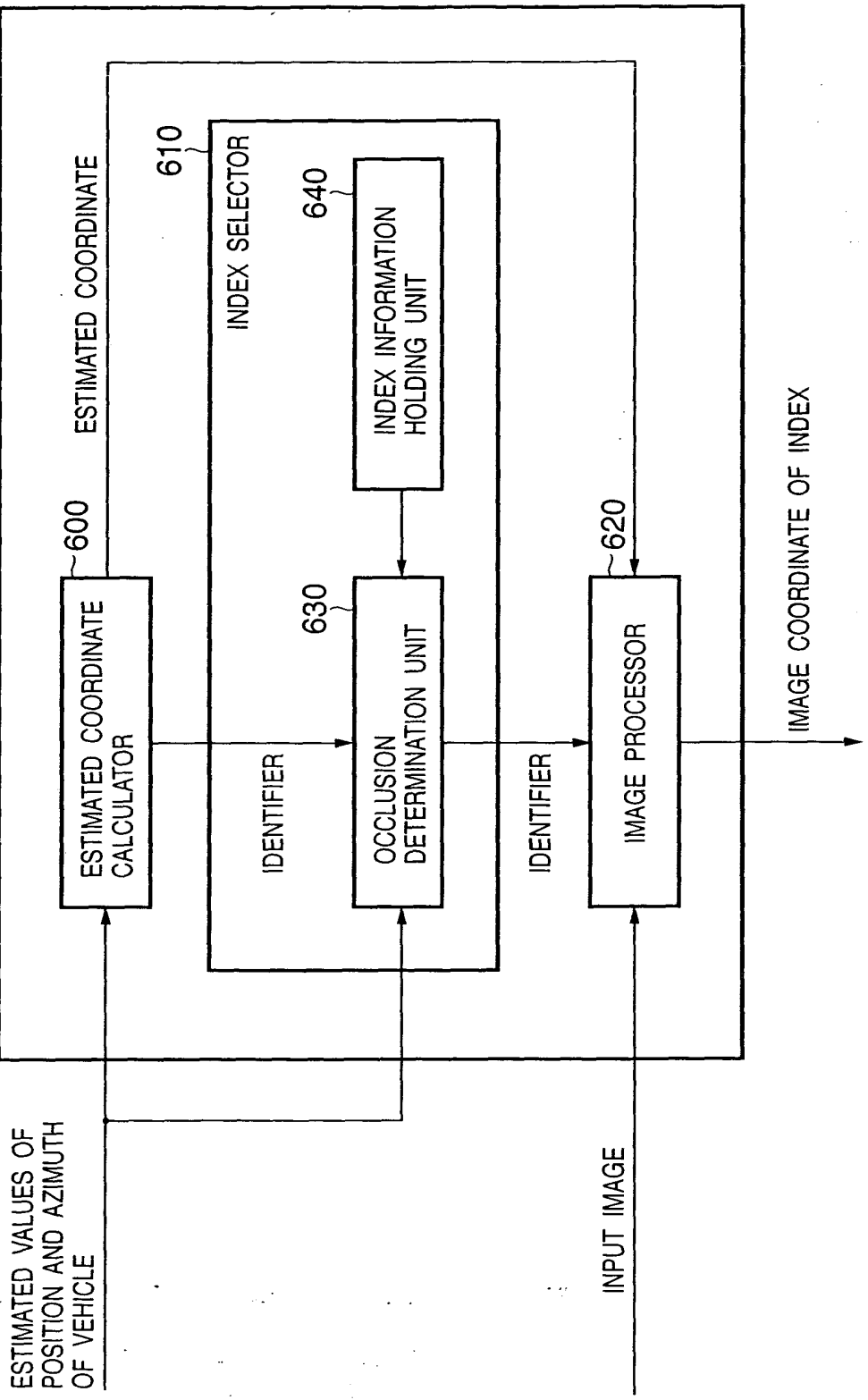

105
ESTIMATED COORDINATE
600
ESTIMATED COORDINATE CALCULATOR
610
INDEX SELECTOR
640
INDEX INFORMATION HOLDING UNIT
630
OCCLUSION DETERMINATION UNIT
620
IMAGE PROCESSOR
IDENTIFIER
IDENTIFIER
IMAGE COORDINATE OF INDEX
ESTIMATED VALUES OF POSITION AND AZIMUTH OF VEHICLE
INPUT IMAGE

FIG. 7

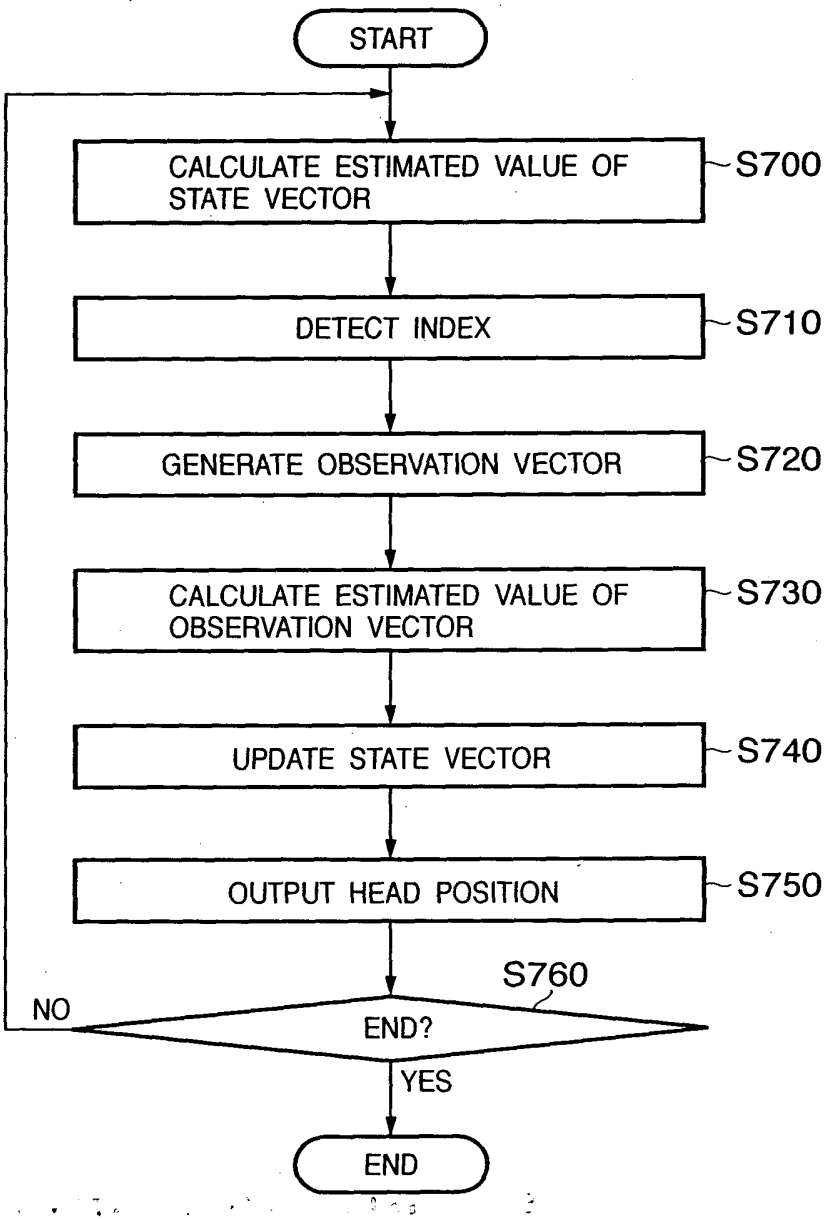

START
CALCULATE ESTIMATED VALUE OF STATE VECTOR
S700
DETECT INDEX
S710
GENERATE OBSERVATION VECTOR
S720
CALCULATE ESTIMATED VALUE OF OBSERVATION VECTOR
S730
UPDATE STATE VECTOR
S740
OUTPUT HEAD POSITION
S750
S760
END?
NO
YES
END

FIG. 8

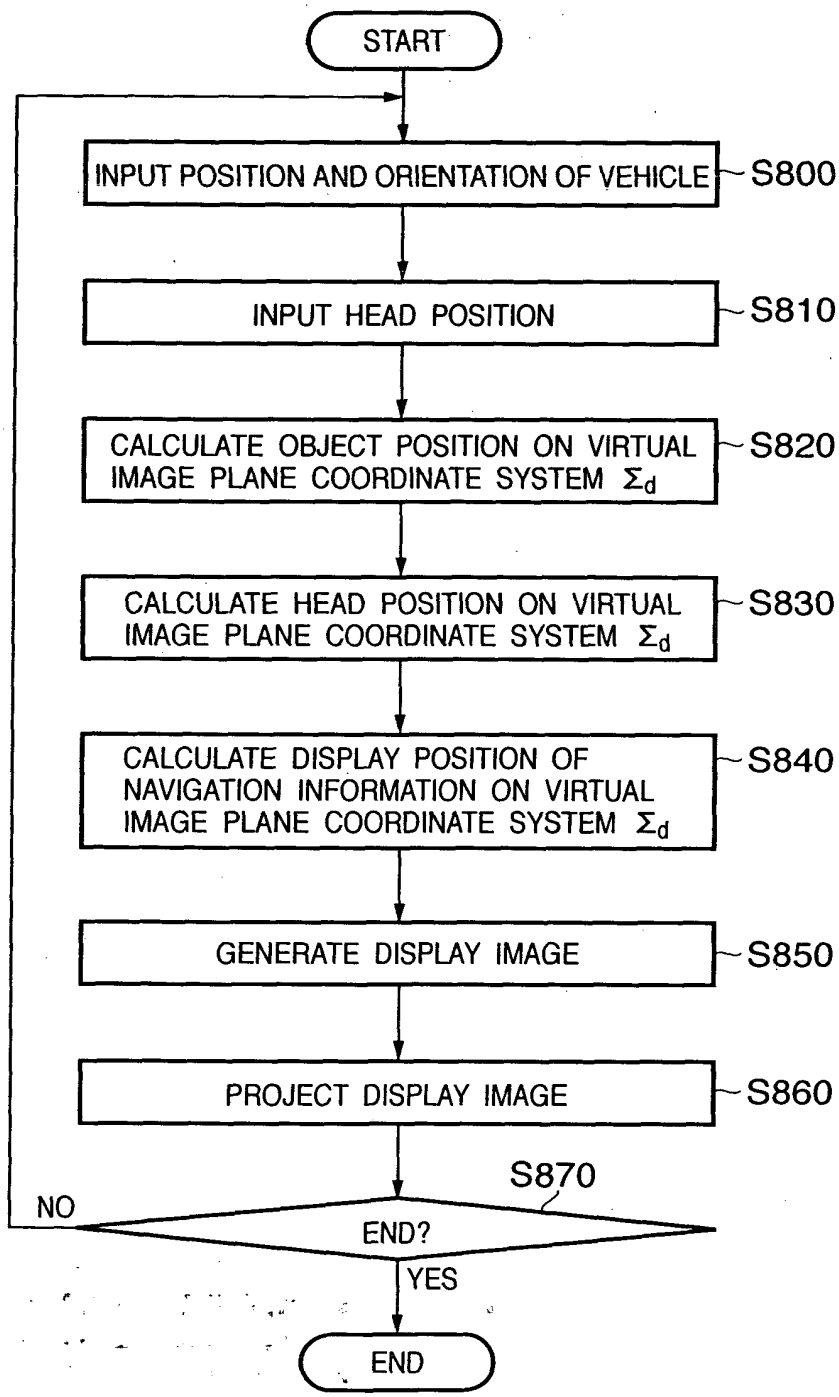

START
INPUT POSITION AND ORIENTATION OF VEHICLE
S800
INPUT HEAD POSITION
S810
CALCULATE OBJECT POSITION ON VIRTUAL IMAGE PLANE COORDINATE SYSTEM Σ_d
S820
CALCULATE HEAD POSITION ON VIRTUAL IMAGE PLANE COORDINATE SYSTEM Σ_d
S830
CALCULATE DISPLAY POSITION OF NAVIGATION INFORMATION ON VIRTUAL IMAGE PLANE COORDINATE SYSTEM Σ_d
S840
GENERATE DISPLAY IMAGE
S850
PROJECT DISPLAY IMAGE
S860
S870
NO
END?
YES
END

FIG. 9

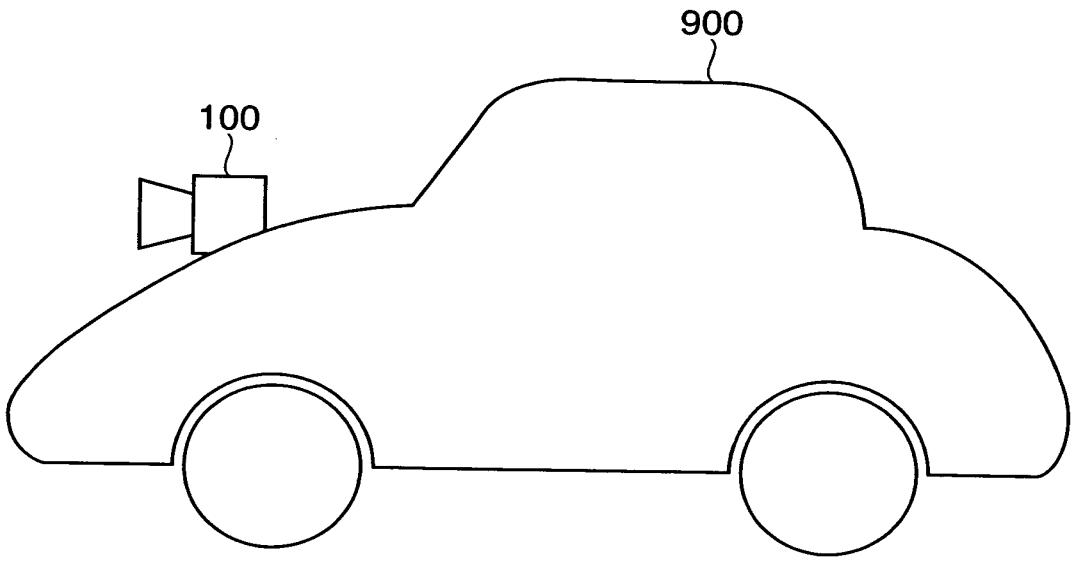


FIG. 10

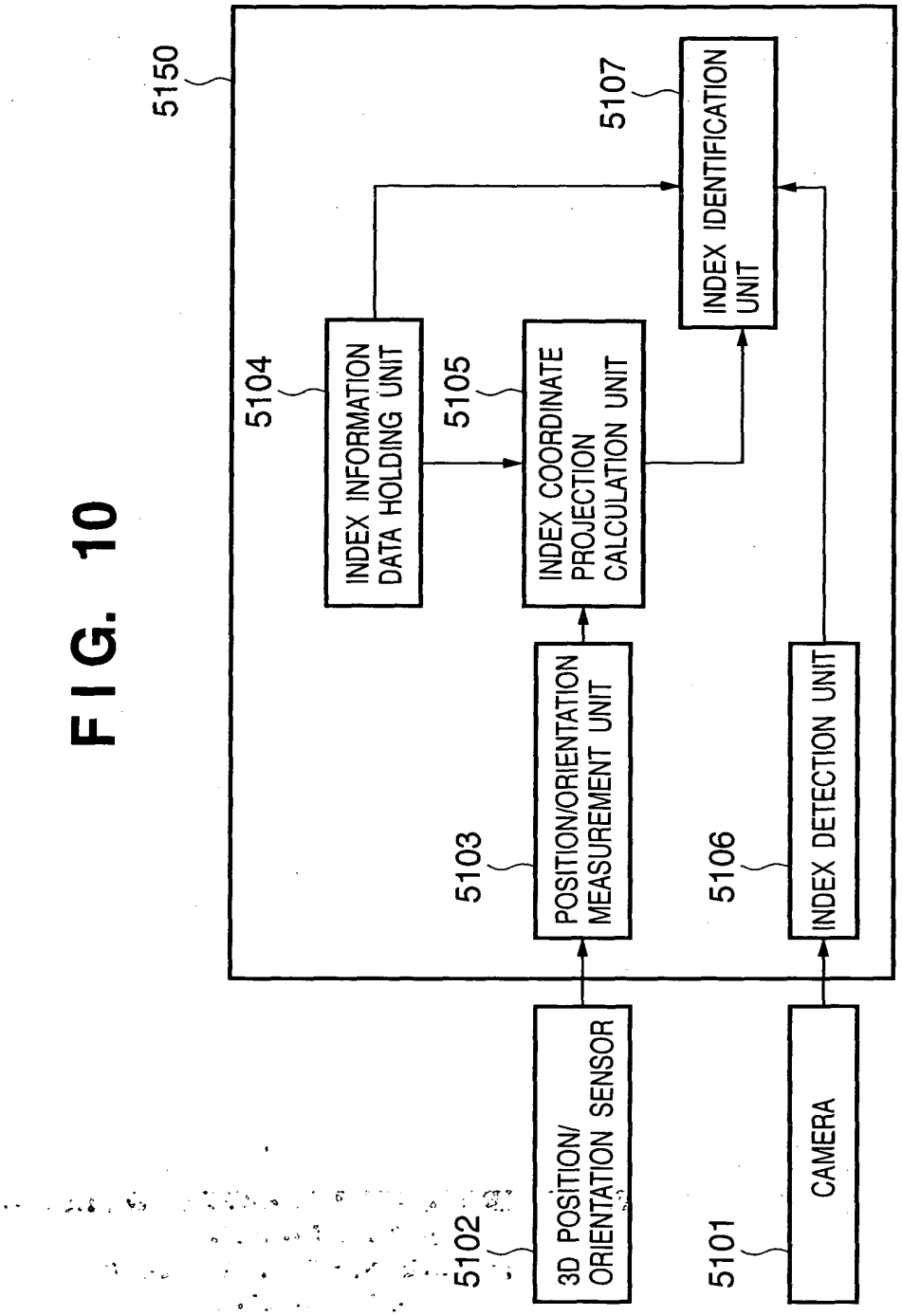

5150
5107
INDEX IDENTIFICATION UNIT
5104
INDEX INFORMATION DATA HOLDING UNIT
5105
INDEX COORDINATE PROJECTION CALCULATION UNIT
5103
POSITION/ORIENTATION MEASUREMENT UNIT
5106
INDEX DETECTION UNIT
5102
3D POSITION/ ORIENTATION SENSOR
5101
CAMERA

FIG. 11

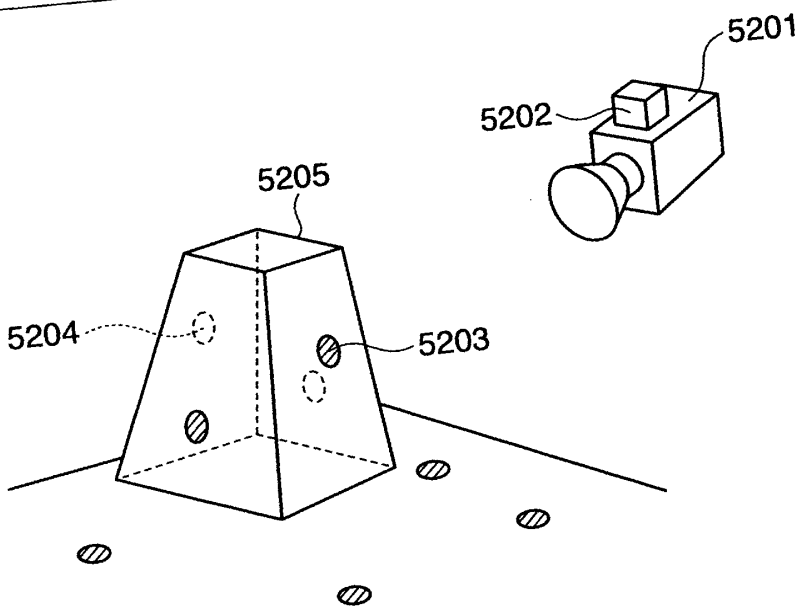


FIG. 12

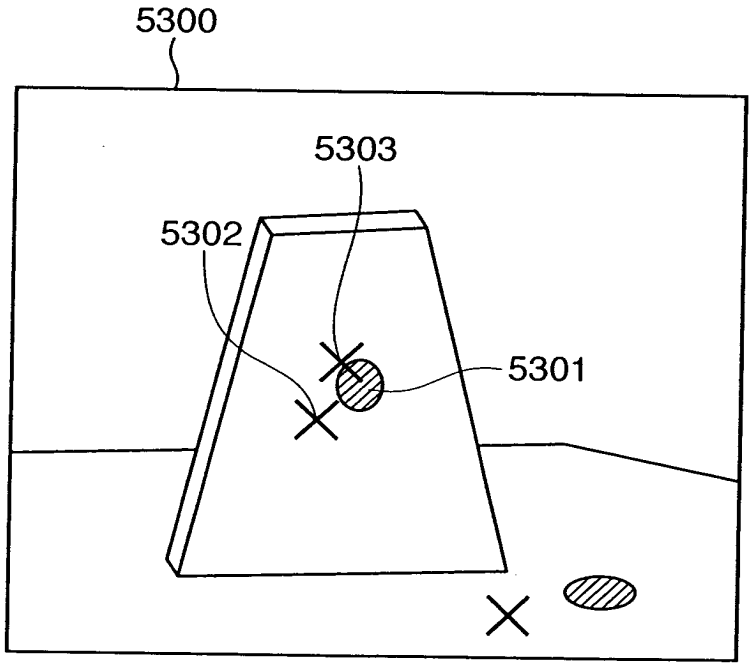


FIG. 13

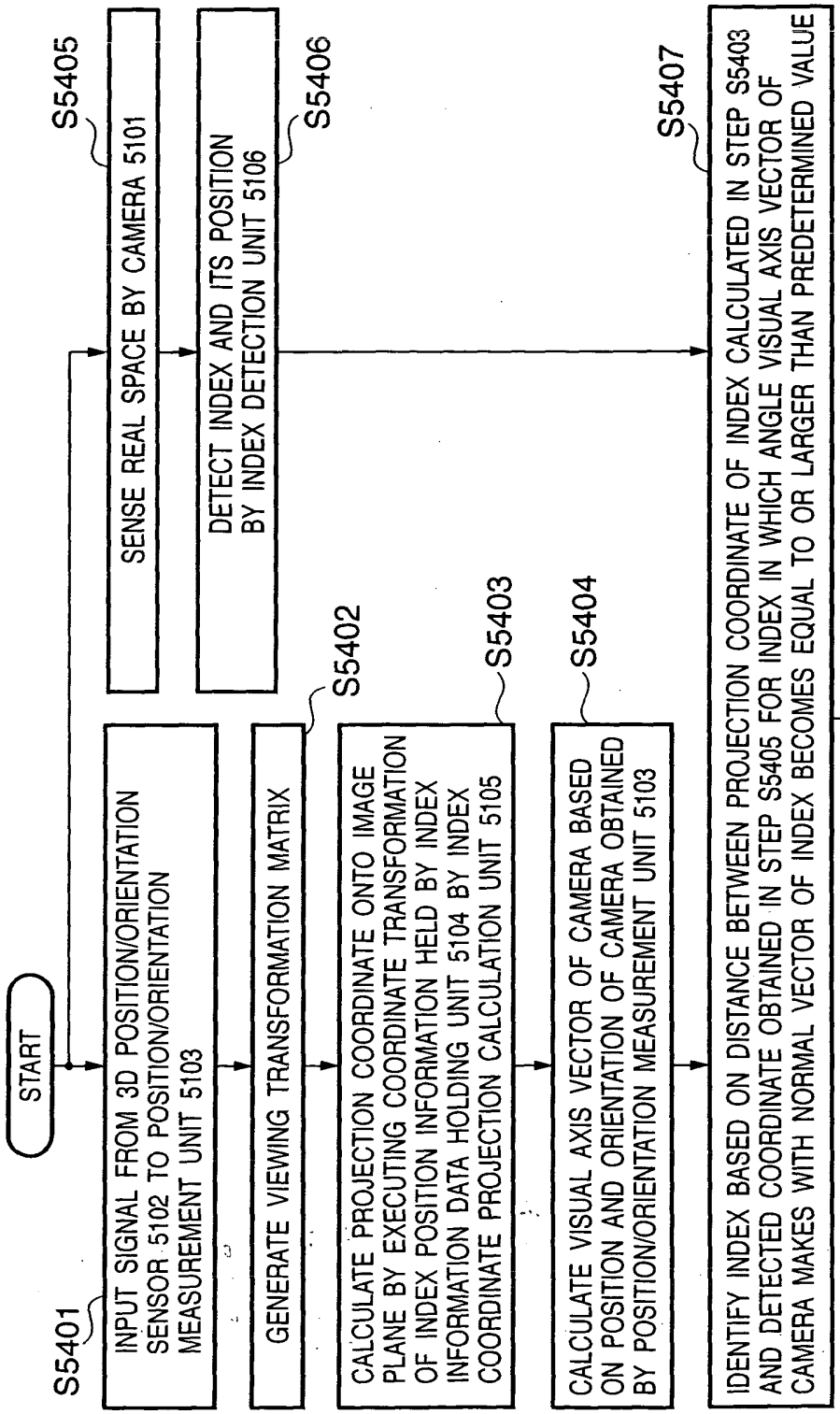

START
S5401
INPUT SIGNAL FROM 3D POSITION/ORIENTATION SENSOR 5102 TO POSITION/ORIENTATION MEASUREMENT UNIT 5103
S5405
SENSE REAL SPACE BY CAMERA 5101
S5406
DETECT INDEX AND ITS POSITION BY INDEX DETECTION UNIT 5106
S5402
GENERATE VIEWING TRANSFORMATION MATRIX
S5403
CALCULATE PROJECTION COORDINATE ONTO IMAGE PLANE BY EXECUTING COORDINATE TRANSFORMATION OF INDEX POSITION INFORMATION HELD BY INDEX INFORMATION DATA HOLDING UNIT 5104 BY INDEX COORDINATE PROJECTION CALCULATION UNIT 5105
S5404
CALCULATE VISUAL AXIS VECTOR OF CAMERA BASED ON POSITION AND ORIENTATION OF CAMERA OBTAINED BY POSITION/ORIENTATION MEASUREMENT UNIT 5103
S5407
IDENTIFY INDEX BASED ON DISTANCE BETWEEN PROJECTION COORDINATE OF INDEX CALCULATED IN STEP S5403 AND DETECTED COORDINATE OBTAINED IN STEP S5405 FOR INDEX IN WHICH ANGLE VISUAL AXIS VECTOR OF CAMERA MAKES WITH NORMAL VECTOR OF INDEX BECOMES EQUAL TO OR LARGER THAN PREDETERMINED VALUE
END

FIG. 14

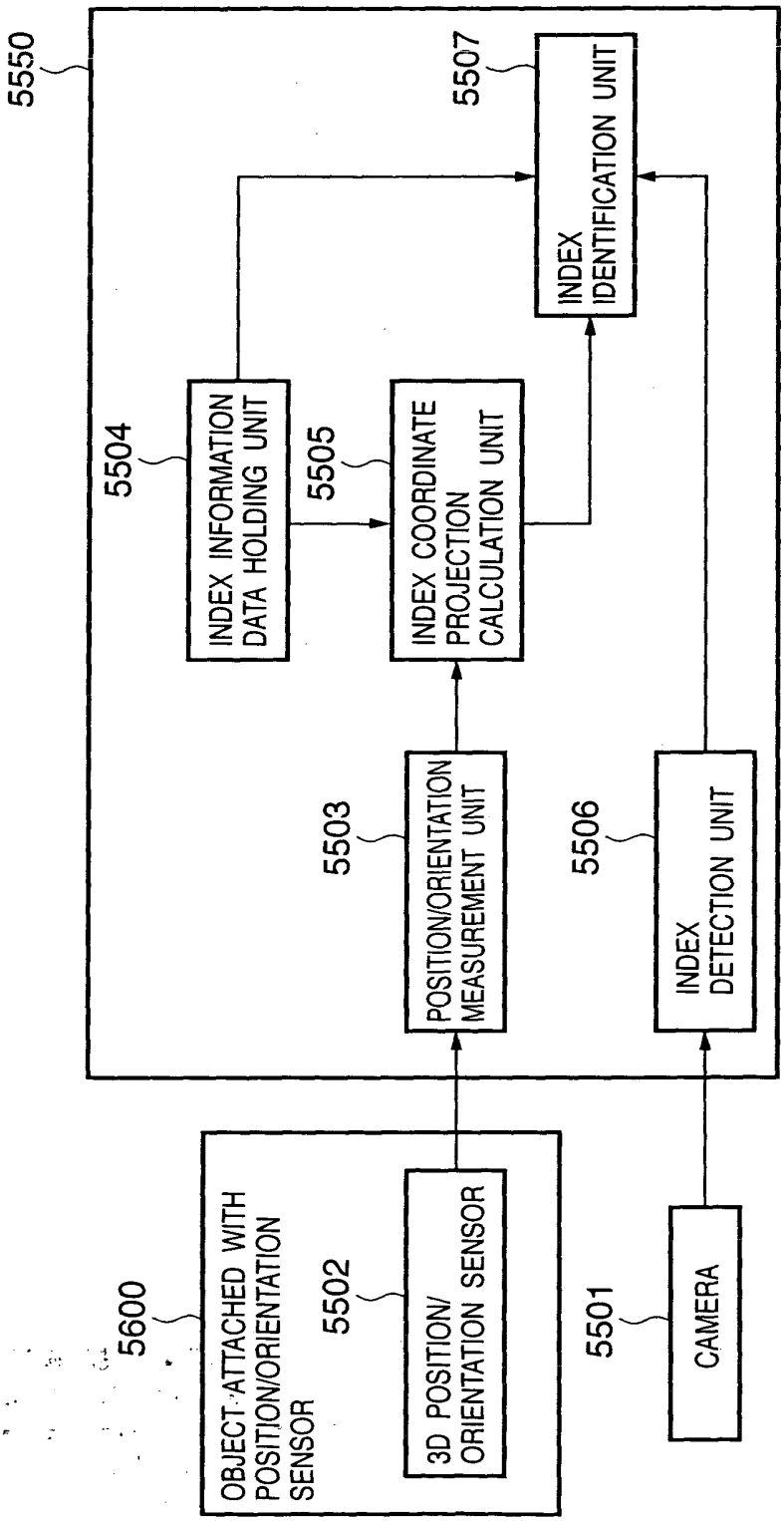

5550
5507
INDEX IDENTIFICATION UNIT
5504
INDEX INFORMATION DATA HOLDING UNIT
5505
INDEX COORDINATE PROJECTION CALCULATION UNIT
5503
POSITION/ORIENTATION MEASUREMENT UNIT
5506
INDEX DETECTION UNIT
5600
OBJECT ATTACHED WITH POSITION/ORIENTATION SENSOR
5502
3D POSITION/ ORIENTATION SENSOR
5501
CAMERA

FIG. 15

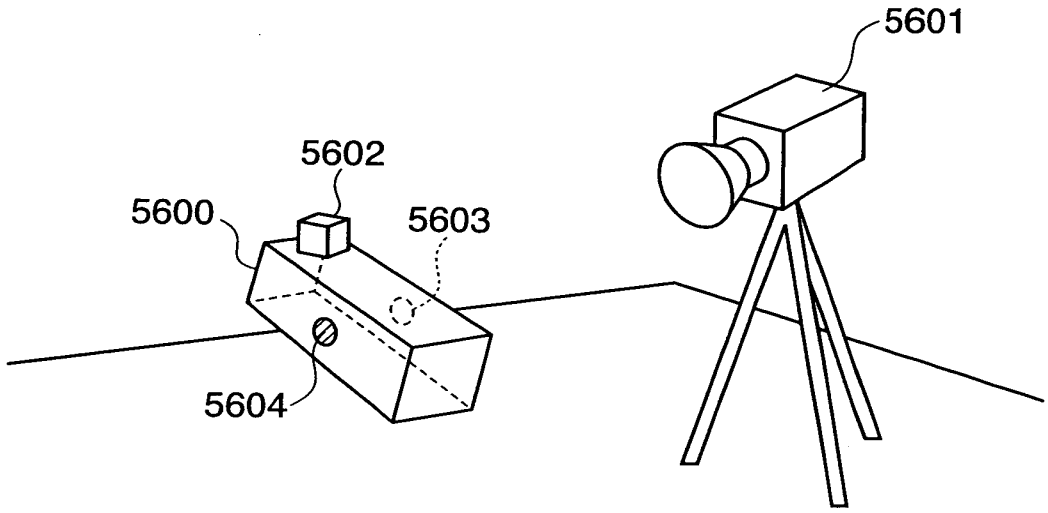


FIG. 16

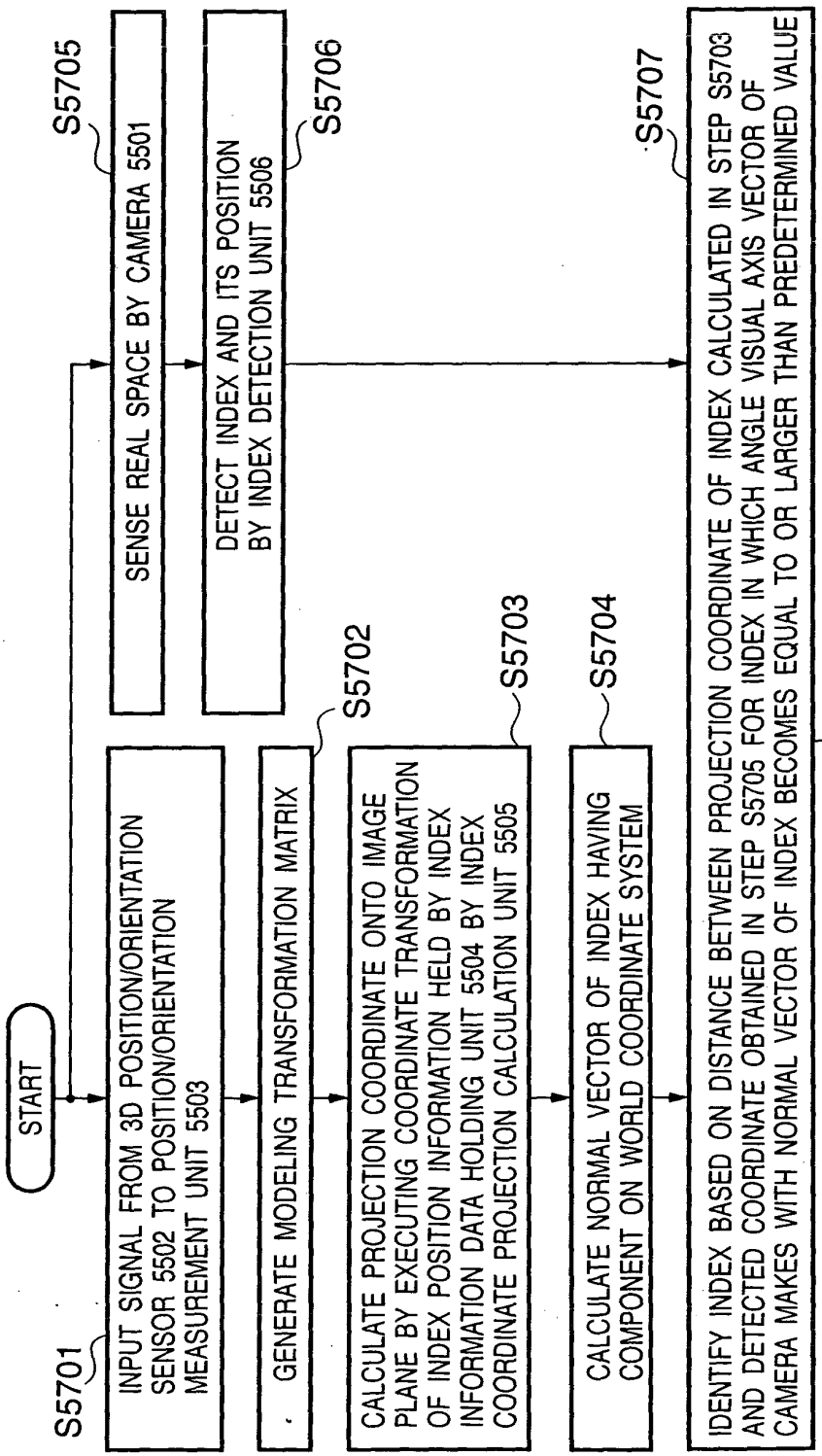

START
S5701
INPUT SIGNAL FROM 3D POSITION/ORIENTATION SENSOR 5502 TO POSITION/ORIENTATION MEASUREMENT UNIT 5503
S5705
SENSE REAL SPACE BY CAMERA 5501
S5706
DETECT INDEX AND ITS POSITION BY INDEX DETECTION UNIT 5506
S5702
GENERATE MODELING TRANSFORMATION MATRIX
S5703
CALCULATE PROJECTION COORDINATE ONTO IMAGE PLANE BY EXECUTING COORDINATE TRANSFORMATION OF INDEX POSITION INFORMATION HELD BY INDEX INFORMATION DATA HOLDING UNIT 5504 BY INDEX COORDINATE PROJECTION CALCULATION UNIT 5505
S5704
CALCULATE NORMAL VECTOR OF INDEX HAVING COMPONENT ON WORLD COORDINATE SYSTEM
S5707
IDENTIFY INDEX BASED ON DISTANCE BETWEEN PROJECTION COORDINATE OF INDEX CALCULATED IN STEP S5703 AND DETECTED COORDINATE OBTAINED IN STEP S5705 FOR INDEX IN WHICH ANGLE VISUAL AXIS VECTOR OF CAMERA MAKES WITH NORMAL VECTOR OF INDEX BECOMES EQUAL TO OR LARGER THAN PREDETERMINED VALUE
END

FIG. 17

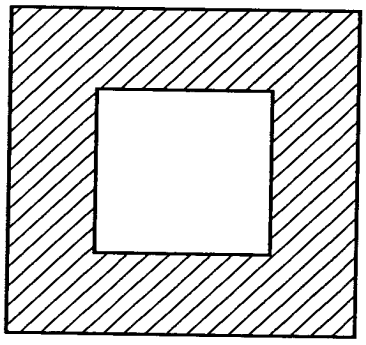


FIG. 18

```
                5901
{               (
  PointMarker p1 {
    Position      ( 0, 0, 80 )  ~5902
    normalVector  ( 1, 0, 0 )   ~5903
    color         red           ~5904
  }
  PointMarker p2 {
    Position      ( 0, 0, −200 )
    normalVector  ( 0, 1, 0 )
    color         red
  }
  PointMarker p3 {
    Position      ( 0, 100, 0 )
    normalVector  ( −1, 0, 0 )
    color         red
  }
  PointMarker p4 {
    Position      ( 0, 80, 0 )
    normalVector  ( 0, −1, 0 )
    color         blue
  }
}
```

FIG. 19

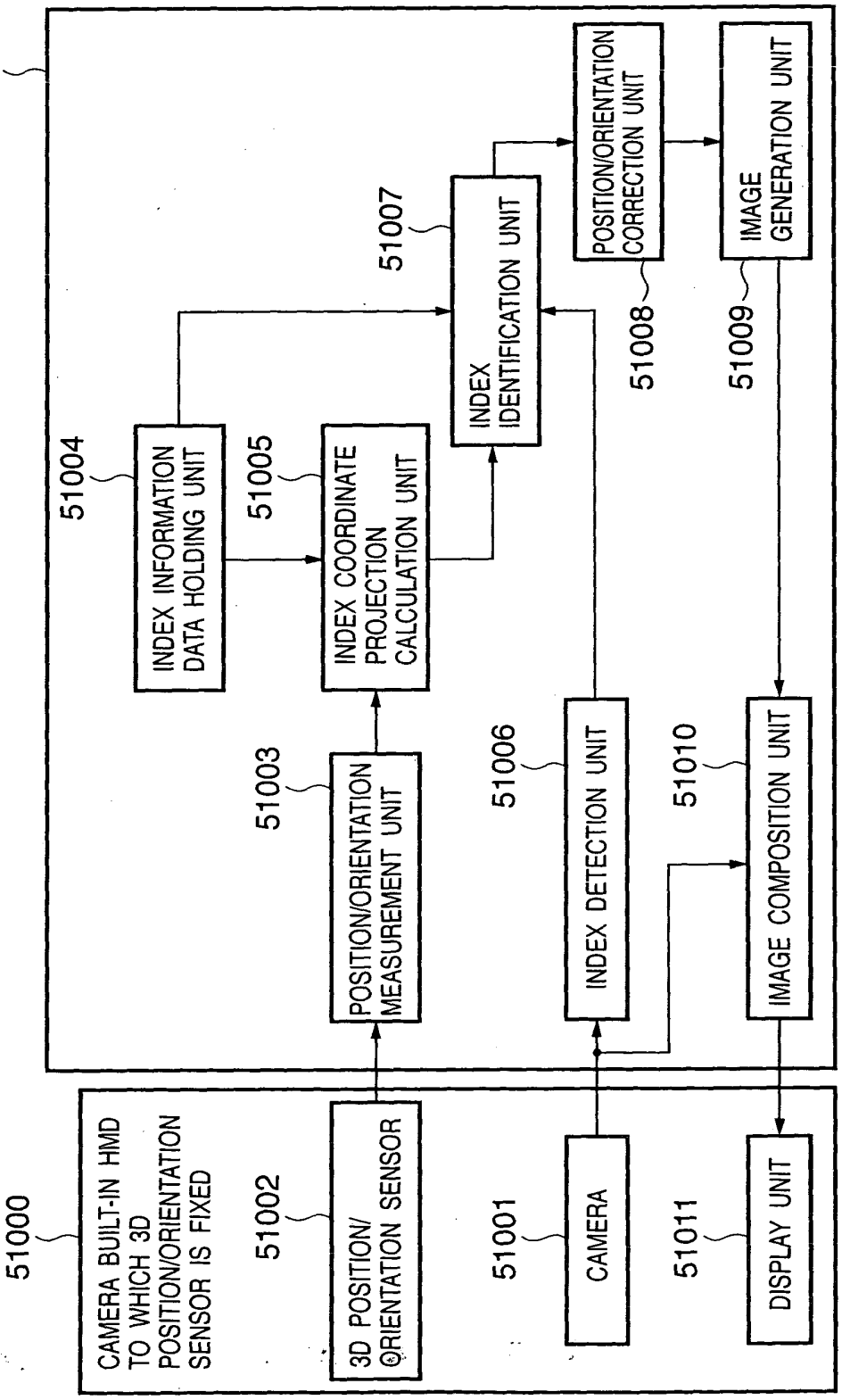

51050
51004
INDEX INFORMATION DATA HOLDING UNIT
51005
INDEX COORDINATE PROJECTION CALCULATION UNIT
51007
INDEX IDENTIFICATION UNIT
51008
POSITION/ORIENTATION CORRECTION UNIT
51009
IMAGE GENERATION UNIT
51003
POSITION/ORIENTATION MEASUREMENT UNIT
51006
INDEX DETECTION UNIT
51010
IMAGE COMPOSITION UNIT
51000
CAMERA BUILT-IN HMD TO WHICH 3D POSITION/ORIENTATION SENSOR IS FIXED
51002
3D POSITION/ ORIENTATION SENSOR
51001
CAMERA
51011
DISPLAY UNIT

FIG. 20

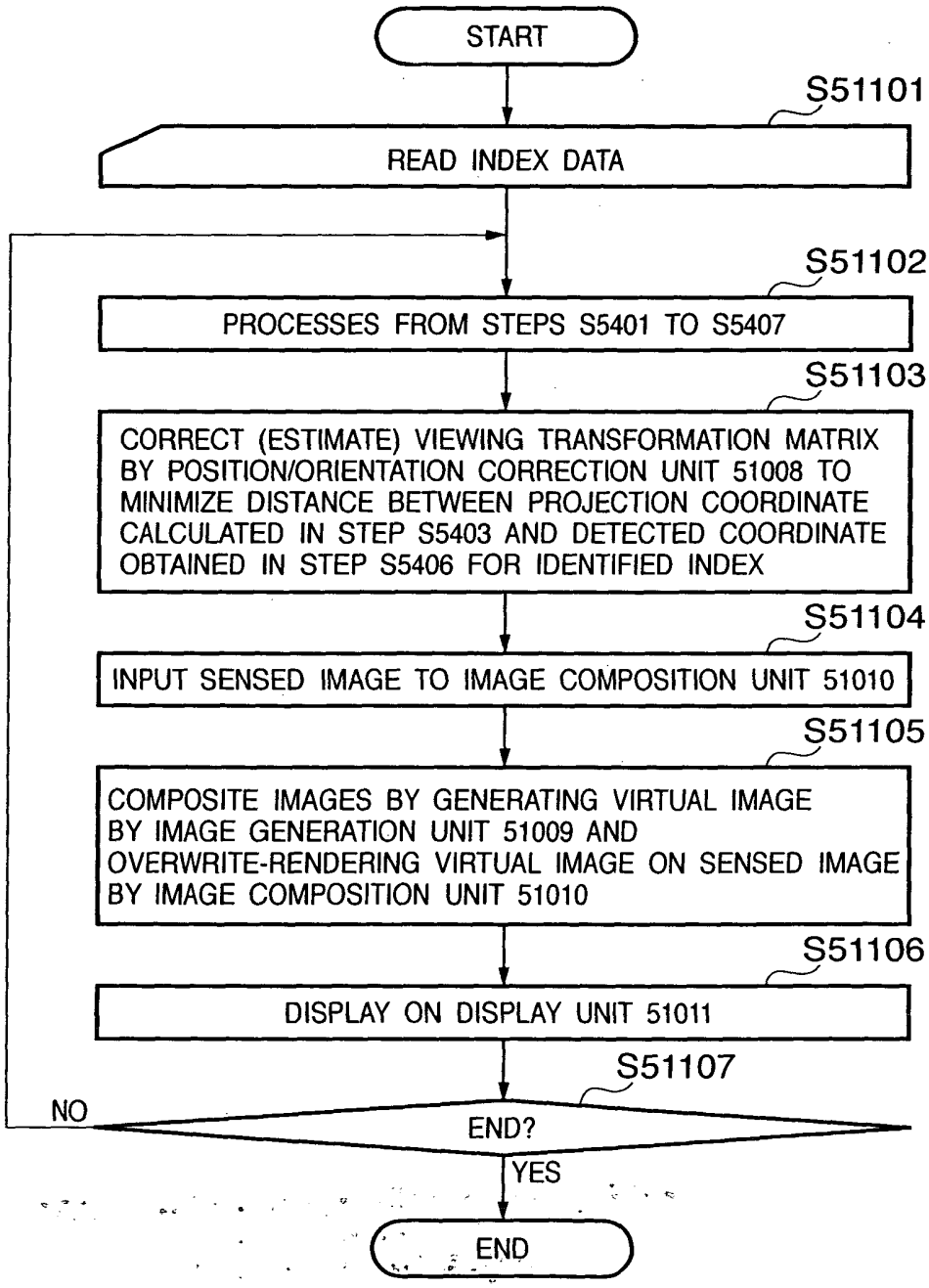

START
S51101
READ INDEX DATA
S51102
PROCESSES FROM STEPS S5401 TO S5407
S51103
CORRECT (ESTIMATE) VIEWING TRANSFORMATION MATRIX BY POSITION/ORIENTATION CORRECTION UNIT 51008 TO MINIMIZE DISTANCE BETWEEN PROJECTION COORDINATE CALCULATED IN STEP S5403 AND DETECTED COORDINATE OBTAINED IN STEP S5406 FOR IDENTIFIED INDEX
S51104
INPUT SENSED IMAGE TO IMAGE COMPOSITION UNIT 51010
S51105
COMPOSITE IMAGES BY GENERATING VIRTUAL IMAGE BY IMAGE GENERATION UNIT 51009 AND OVERWRITE-RENDERING VIRTUAL IMAGE ON SENSED IMAGE BY IMAGE COMPOSITION UNIT 51010
S51106
DISPLAY ON DISPLAY UNIT 51011
S51107
NO
END?
YES
END

FIG. 21

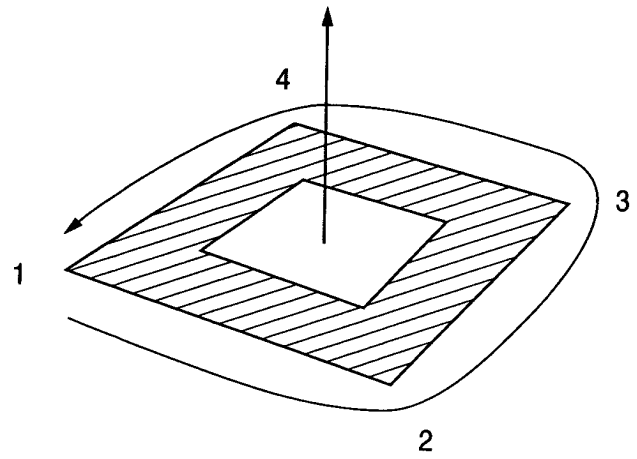
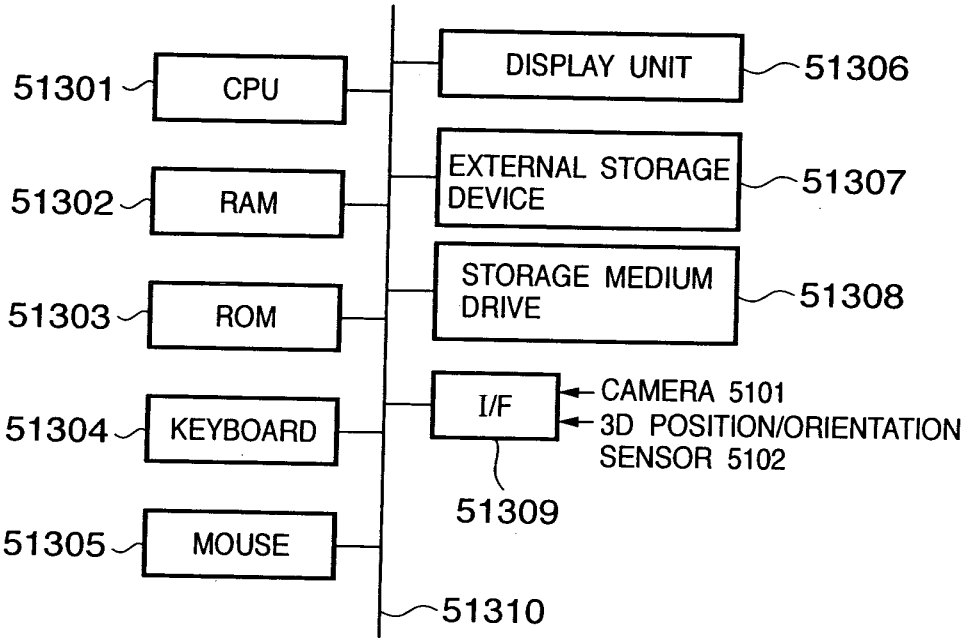


FIG. 22


51301
CPU
51302
RAM
51303
ROM
51304
KEYBOARD
51305
MOUSE
DISPLAY UNIT
51306
EXTERNAL STORAGE DEVICE
51307
STORAGE MEDIUM DRIVE
51308
I/F
CAMERA 5101
3D POSITION/ORIENTATION SENSOR 5102
51309
51310